REMARKS

Applicants have reviewed the entire specification. Applicants have amended claims 1-2, 7-8, 10, 12-14, and 16.

Claim Rejections - 35 USC §103

Claims 1, 3, 6, 13, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. (US Patent 6,232,706) in view of Yaniv et al. (US Patent 6,312,303).

The Examiner, in the Office action, rejected independent claim 1 using Dai et al. '706 in view of Yaniv et al. '303. Applicants have amended claim 1. Applicants submit that claim 1, as amended, and those claims depending therefrom are now in condition for allowance.

Claim 1, as amended, recites in part:

> ...providing a substrate having a flat surface;
>
> ...forming a carbon nanotube array extending from the selected area, the carbon nanotube array having a flat bottom surface corresponding to the flat surface of the substrate;
>
> forming a cathode electrode on a top of the carbon nanotube array; and
>
> removing the substrate so as to expose the flat bottom surface of the carbon nanotube array so that the flat bottom surface of the carbon nanotube array is thereby configured for acting as an electron emitting surface of the carbon nanotube-based field emission device. (Emphasis added.)

Applicants submit that the method as set forth in amended claim 1 is neither taught, disclosed, nor suggested by Dai et al. '706, Yaniv et al. '303, or any of the other cited references, taken alone or in combination.

Dai et al. '706 discloses a method of making a field emission device 20. As shown in FIG. 2 and Col. 3, line 46-Col. 4, line 10 of Dai et al. '706, the method includes the following steps:

step A, a silicon substrate 22 is electrochemically etched to form a porous layer 24;

step B, catalytically active iron oxide patterns 26 are formed on the porous layer 24; and

step C, carbon nanotube bundles 28 are grown perpendicular to the substrate 22.

There is no specific disclosure or suggestion in the method of Dai et al. '706 that the substrate has a flat surface, the grown carbon nanotube bundles have a flat bottom surface corresponding to the flat surface of the substrate, a cathode electrode is formed on the top of the carbon nanotube bundles, and the substrate is removed to expose the bottom surface of the carbon nanotube bundles so that the flat bottom surface of the carbon nanotube array is thereby configured for acting as an electron emitting surface of the carbon nanotube-based field emission device. Thus, Dai et al. '706 fails to teach or suggest every element in claim 1, as amended.

Furthermore, as shown in FIG. 1 and Col. 3, lines 24-26 of Dai et al. '706, the carbon nanotube bundles 28 can have a flat top 34 or a bowl-shaped top 36. As shown in FIG. 1 and Col. 3, lines 28-29 of Dai et al. '706, the carbon nanotube bundles 28 have sharp edges 38 and corners, which serve as field emission regions. It is clear that in Dai et al. '706, the top 34/36 of the carbon nanotube bundles 28 acts as an electron emission surface of the field emission device 20. This is different from the claimed invention, in which the flat bottom surface of the nanotube array is configured for acting as an electron emitting surface of the carbon nanotube-based field emission device. This feature is achieved by forming a cathode electrode on the top of the carbon nanotube array and removing the substrate so as to expose the flat bottom surface of the carbon nanotube array, which has been clearly recited in claim 1, as amended.

The Examiner states that Dai et al. '706 teaches removing the substrate on which nanotubes were formed on Col. 4, lines 58-63, and the use of nanotube bundles in an FED on Col. 3, lines 4-28. However, upon closer inspection, the motivation of Dai et al. '706 to remove the substrate is to observe that the substrate remains capable of growing carbon nanotubes, thereby confirming that the nanotube bundles grow in "base growth" mode (col. 4, lines 58-63). Thus, "removing the substrate" is not a step of the method of Dai et al. '706, and the nanotube bundles in an FED must cooperate with the substrate (Col. 3, lines 4-28).

Specifically, Dai et al. '706 does not teach or disclose reattaching the carbon nanotubes, removed from the substrate at col. 4, lines 58-63. As such, without reattachment to a substrate or other conductor, such nanotubes

would be inoperative as field emitters. Accordingly, the step of "removing the substrate" as taught by Dai et al. '706 is not disclosed or suggested as part of a process of achieving an operable field emitter device. In this regard the preamble ("A method for making a carbon nanotube-based field emission device ...") of claim 1, as amended, must be given weight.

Further, any attempts to modify Dai et al. '706 with any other reference to remove the substrate would undoubtedly change the principle of operation of Dai et al. '706 (i.e., the top 34/36 of the carbon nanotube bundles 28 acts as an electron emission surface of the field emission device 20) and potentially could be considered to render Dai et al. '706 unsatisfactory (i.e., the top 34/36 of the carbon nanotube bundles 28 cannot act as an electron emission surface of the field emission device 20). MPEP §2143.01. Accordingly, Applicants submit that any reference combination using Dai et al. '706 as the primary reference could not be deemed to render claim 1, as amended, obvious under 35 U.S.C. §103.

Yaniv et al. '303 discloses a method for aligning carbon nanotubes within a host phase. As shown in FIG. 7 and Col. 2, line 39-Col. 3, line 50 of Yaniv et al. '303, the method includes the following steps:

step 701, disposing carbon nanotubes in a host phase;

step 702, causing the host phase to align resulting in alignment of carbon nanotubes;

step 703, binding the alignment;

step 704, slicing and/or polishing and/or etching; and

step 705, mounting on a cathode.

It is clear that in Yaniv et al. '303, the carbon nanotubes are aligned carbon nanotubes in the host phase, but Yaniv et al. '303 does not disclose or suggest a carbon nanotube array having a flat bottom surface, as required in claim 1, as amended. Particularly, the bottom surfaces of the carbon nanotubes are enclosed in the host phase but not exposed, as required in claim 1, as amended. Furthermore, as shown in FIG. 9 and Col. 3, lines 41-46, the cathode is deposited on the top of the host phase but not on the top of carbon nanotubes, as required in claim 1, as amended. Thus, Yaniv et al. '303 fails to teach or suggest every element in claim 1, as amended, and is unable to overcome the shortcomings associated with Dai et al. '706.

Accordingly, Applicants submit that the combination of Dai et al. '706 in view of Yaniv et al. '303 fails to teach or suggest the carbon nanotube-based field emission device, as set forth in amended claim 1.

Therefore, amended claim 1 clearly recites novel and unobvious physical subject matter over any proposed combination of Dai et al. '706 and Yaniv et al. '303. Applicants submit that the novel and unobvious physical features of amended claim 1 produce new and unexpected results over and above Dai et al. '706, Yaniv et al. '303 or any of the other cited references, taken alone or in combination. The new and unexpected results associated with the claimed method are associated with the exposed flat bottom surface of the carbon nanotube array. The exposed flat bottom surface of the carbon nanotube array acts as an electron emitting surface of the device. Thus, this flat surface effect improves electron emission uniformity and stability of the manufactured device and thus helps to overcome the

shortcoming of the prior device manufactured by the prior method whose electron emitting surface is neither predictable nor controllable (see Paras. **[0003], [0006]**). Applicants' invention is therefore clearly superior to that of any one of Dai et al. '706 or Yaniv et al. '303, or any proposed combination thereof. The novel features of Applicants' invention, which give effect to these results, are clearly recited in amended claim 1.

Therefore, it would not have been obvious to one of ordinary skill in the art to combine Dai et al. '706 and Yaniv et al. '303 to embody and disclose the present invention as set forth in amended claim 1.

Dependent claims 3 and 6, respectively, incorporate all the subject matter of independent claim 1 and add respective additional subject matter. As detailed above, it is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claims 3 and 6 are also allowable, and Applicants request that the rejection relating thereto be removed.

The Examiner, in the Office Action, rejected independent claim 13 using Dai et al. '706 in view of Yaniv et al. '303. Applicants have amended claim 13. Applicants submit that claim 13, as amended, and those claims depending therefrom, are now in condition for allowance.

Claim 13, as amended, recites in part:

...providing an insulative substrate having a <u>flat</u> surface;

forming a carbon nanotube array extending from a selected area of

the flat surface, the carbon nanotube array having a flat bottom surface corresponding to the flat surface of the insulative substrate;

depositing a layer of metallic material on a top of the carbon nanotube array; and

removing the insulative substrate to expose the flat bottom surface of the carbon nanotube array so that the flat bottom surface of the carbon nanotube array is thereby configured for acting as an electron emitting surface of the carbon nanotube-based field emission device. (Emphasis added.)

Applicants submit that the method as set forth in amended claim 13 is neither taught, disclosed, nor suggested by Dai et al. '706, Yaniv et al. '303, or any of the other cited references, taken alone or in combination.

For reasons similar to those asserted above in relation to the rejection of claim 1 under 35 U.S.C. § 103 on Dai et al. '706 in view of Yaniv et al. '303, Applicants submit that subject matter as set forth in amended 13 is neither taught, disclosed, nor suggest by Dai et al. '706, Yaniv et al. '303, or any of the other cited references, taken alone or in combination. Moreover, Applicants submit that the novel and unobvious physical features of amended claim 13 produces new and unexpected results over and above Dai et al. '706, Yaniv et al. '303 or any of the other cited references, taken alone or in combination. Applicants' invention is therefore clearly superior to that of any one of Dai et al. '706 or Yaniv et al. '303, or any proposed combination thereof. The novel features of Applicants' invention, which give effect to these results, are clearly recited in amended claim 13.

Therefore, it would not have been obvious to one of ordinary skill in the art to combine Dai et al. '706 and Yaniv et al. '303 to embody and disclose the present invention claimed in amended claim 13.

Dependent claim 15 incorporates all the subject matter of independent claim 13 and adds respective additional subject matter. As detailed above, it is asserted that claim 13 is allowable. Thus, it is submitted that the dependent claim 15 is also allowable, and Applicants request that the rejection relating thereto be removed.

Claims 4, 5, and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. (US Patent 6,232,706) in view of Yaniv et al. (US Patent 6,312,303) and in further view of Hsu (US Publication 20020042241).

Dependent claims 4, 5, 7 incorporate all the subject matter of independent claim 1, respectively, and add respective additional subject matter. As detailed above, it is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claims 4, 5, 7 are also allowable, and Applicants request that the rejection relating thereto be removed.

Claims 2, 8-9, 11, 12, 14, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. (US Patent 6,232,706) in view of Yaniv et al. (US Patent 6,312,303) and in further view of Mirkin et al. (US Publication 20030049381).

The Examiner, in the Office Action, rejected independent claim 8 using Dai et al. '706 in view of Yaniv et al. '303 and further in view of Mirkin et al. Applicants have amended claim 8. Applicants submit that claim 8, as amended, and those claims depending therefrom are now in condition for allowance.

Claim 8, as amended, recites in part:

> ...providing a substrate having a surface which has a variation in flatness of less than 1 micron;
>
> forming a carbon nanotube array extending from a selected area of the surface of the substrate, the carbon nanotube array having a flat bottom surface corresponding to the flat surface of the substrate;
>
> forming a cathode electrode on a top of the carbon nanotube array; and
>
> removing the substrate so as to expose the flat bottom surface of the carbon nanotube array so that the flat bottom surface of the carbon nanotube array is thereby configured for acting as an electron emitting surface of the carbon nanotube-based field emission device. (Emphasis added.)

Applicants submit that the method as set forth in amended claim 8 is neither taught, disclosed, nor suggested by Dai et al. '706, Yaniv et al. '303, Mirkin et al. or any of the other cited references, taken alone or in combination.

Mirkin et al. discloses a lithographic method referred to as "dip pen" nanolithography (DPN). DPN utilizes a scanning probe microscope (SPM) tip as a "pen", a solid-state substrate as "paper" and a patterning compound as "ink". The tip is coated with the ink and is contacted with the substrate so that the ink is applied to the substrate by capillary transport to produce a desired pattern (see Para. [0011]). As shown in FIG 2D and Para. [0142] of Mirkin et al., smoother and more contiguous lines could be drawn by increasing the line width to 100 nm or by using a smoother substrate.

It is clear that the substrate in Mirkin et al. is used to have the ink deposited thereon but not to have carbon nanotube array formed therefrom. Furthermore, "100nm" actually refers to the drawn line width, not to any particular variation in flatness of the surface of the substrate. Thus, Mirkin et al. fails to teach or suggest every element in claim 8, as amended, and is unable to overcome the shortcomings of Dai et al. '706 and Yaniv et al. '303, set forth above.

For reasons similar to those asserted above in relation to the rejection of claim 1 under 35 U.S.C. § 103 on Dai et al. '706 in view of Yaniv et al. '303, Applicants submit that subject matter as set forth in amended 8 is neither taught, disclosed, nor suggest by Dai et al. '706, Yaniv et al. '303, Mirkin et al., or any of the other cited references, taken alone or in combination. Moreover, Applicants submit that the novel and unobvious physical features of amended claim 8 produces new and unexpected results over and above Dai et al. '706, Yaniv et al. '303, Mirkin et al., or any of the other cited references, taken alone or in combination. Applicants' invention is

therefore clearly superior to that of any one of Dai et al. '706, Yaniv et al. '303 or Mirkin et al., or any proposed combination thereof. The novel features of Applicants' invention, which give effect to these results, are clearly recited in amended claim 8.

Therefore, it would not have been obvious to one of ordinary skill in the art to combine Dai et al. '706, Yaniv et al. '303 and Mirkin et al. to embody and disclose the present invention claimed in amended claim 8.

Dependent claims 9 and 11-12, respectively, incorporate all the subject matter of independent claim 8 and add respective additional subject matter. As detailed above, it is asserted that claim 8 is allowable. Thus, it is submitted that the dependent claims 9 and 11-12 are also allowable, and Applicants request that the rejection relating thereto be removed.

Dependent claim 2 incorporates all the subject matter of independent claim 1 and adds respective additional subject matter. As detailed above, it is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claim 2 is also allowable, and Applicants request that the rejection relating thereto be removed.

The Examiner, in the Office Action, rejected dependent claims 14, 16 using Dai et al. '706 in view of Yaniv et al. '303 and further in view of Mirkin et al. Applicants have amended claims 14 and 16. Dependent claims 14 and 16, respectively, incorporate all the subject matter of independent claim 13 and add respective additional subject matter. As

detailed above, it is asserted that claim 13 is allowable. Thus, it is submitted that the dependent claims 14 and 16 are also allowable, and Applicants request that the rejection relating thereto be removed.

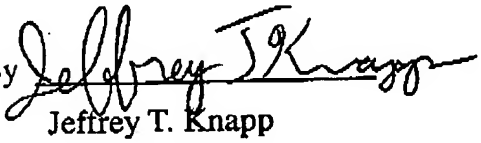
Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dai et al. (US Patent 6,232,706) in view of Yaniv et al. (US Patent 6,312,303) and in further view of Mirkin et al. (US Publication 20030049381) and in further view of Samalley et al. (US Patent 6,183,714).

Dependent claim 10 incorporates all the subject matter of independent claim 8 and adds respective additional subject matter. As detailed above, it is asserted that claim 8 is allowable. Thus, it is submitted that the dependent claim 10 is also allowable, and Applicants request that the rejection relating thereto be removed.

Conclusion

For all the above reasons, Applicants assert that all the pending claims are now in proper form and are patentably distinguishable over the prior art. Therefore applicants submit that this application is now in condition for allowance, and an action to this effect is earnestly requested.

Respectfully submitted,
Liang Liu et al.

By 

Jeffrey T. Knapp
Registration No.: 45,384
Foxconn International, Inc.
1650 Memorex Drive
Santa Clara, CA 95050
Tel. No.: 714/626-1229